

## OVERALL EXPECTATIONS

- evaluate the importance of recent contributions to our knowledge of genetic processes, and analyze the social and ethical implications of genetic and genomic research
- investigate genetic processes, including those that occur during meiosis, and analyze data to solve basic genetics problems involving monohybrid and dihybrid crosses
- demonstrate an understanding of concepts, processes, and technologies related to the transmission of hereditary characteristics

## BIG IDEAS

- Genetic and genomic research can have social and environmental implications.
- Variability and diversity of organisms result from the distribution of genetic materials during the process of meiosis.

### UNIT TASK PREVIEW

In the Unit Task you will investigate the case history of an individual with a genetic disorder. You will examine the individual's family history and learn how the disorder was inherited. You will also learn about the disease itself, how it is diagnosed and treated, and what the prognosis is for individuals affected with the disorder.

The Unit Task is described in detail on page 264. As you work through the unit look for Unit Task Bookmarks to see how information in the section relates to the Unit Task.



### SHAPING OUR PAST AND OUR FUTURE

The science of genetics is revolutionizing biology. At the beginning of the last century, we were just beginning to understand the nature of inheritance. By the middle of that century, we had learned that chromosomes carry genetic information that is inherited from generation to generation. Later in the century, scientists were able to identify the structure of DNA. Today, we have the ability to read the genetic instructions of an individual, as well as the technology to transfer genetic information between individuals of different species. What are the applications and implications of these revolutions in genetics?

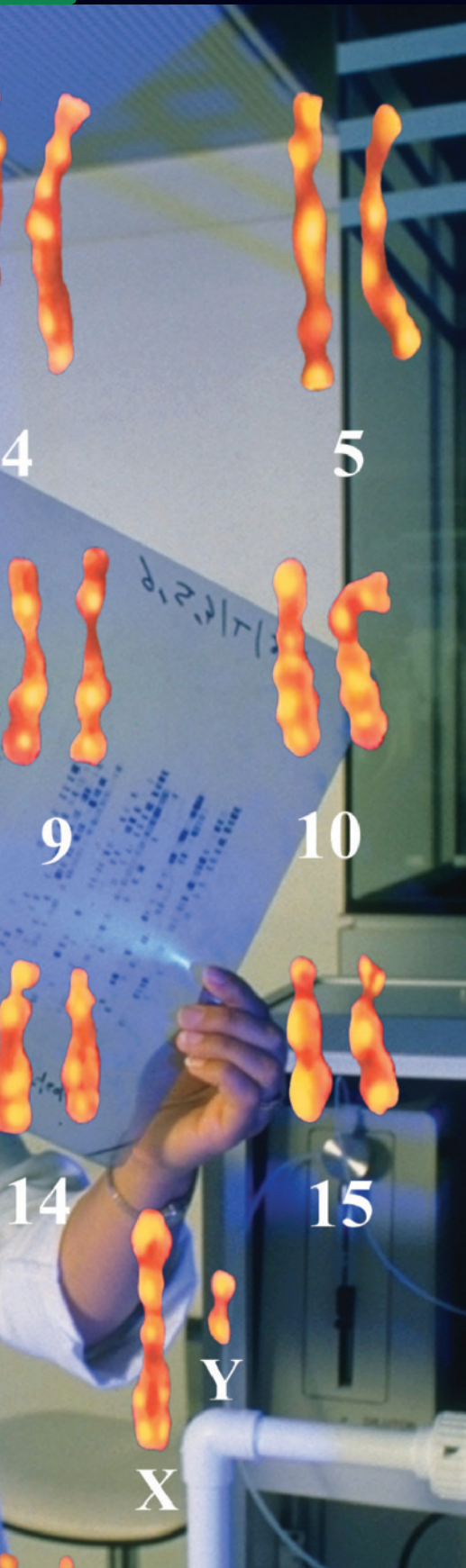
In hospitals, newborn babies are routinely screened for genetic disorders, enabling diagnosis, treatment, and reduced suffering. In courtrooms, DNA fingerprinting is used to distinguish between guilt and innocence. Organisms that have been genetically modified are used in agriculture to produce new foods, in forestry to yield faster-growing trees, and in the pharmaceutical industry to produce new and more effective drugs. DNA testing is now available to anyone, for a price.

The science of genetics and its applications have significant implications for society. Many of these applications offer the promise of improved healthcare, more abundant and nutritious food, and benefits for society and the environment. But what are the costs and risks of this revolution in science? Will the introduction of genetically modified organisms harm the environment? Will genetically modified organisms be used in a harmful way? How will genetic information be used, and will it be abused?

The future of genetics is filled with opportunities and burdened with difficult questions. Although many breakthroughs in genetics research have benefited society, many applications of genetics remain controversial. This unit will introduce you to the science of genetics and heredity. You will learn how the science of genetics and its associated technologies have shaped your world and will shape your future.

#### Questions

1. Make a list of six dog breeds. For each breed listed, identify which of its characteristics (physical and/or behavioural) are inherited (passed from generation to generation.)
2. (a) Brainstorm a list of eight human physical traits that are inherited but variable—for example, eye colour.  
(b) List some human behavioural traits that you think are inherited.
3. Many people are opposed to the use of organisms in agriculture that have been genetically modified. Why do you think this is? Why do you think others are so strongly in favour of their use?
4. If you could change any kind of organism, which kind would you choose, and what specific characteristic(s) would you change? Explain your answer.



## CONCEPTS

- identify cell structures and describe their functions
- use appropriate terminology related to cells
- explain the importance of cell division in growth and repair
- describe the phases of mitosis and cytokinesis
- recognize that errors of cell division have the potential to cause disease

## SKILLS

- draw labelled biological drawings
- examine cells under a microscope
- communicate ideas, plans, procedures, results, and conclusions using appropriate language and formats
- analyze and interpret qualitative and/or quantitative data
- apply the mathematical concepts of ratio and proportion

## Concepts Review

- Match the cell structures on the left with the most appropriate descriptions on the right. **K/U**

(a) mitochondria	(i) site of photosynthesis
(b) nucleus	(ii) structure within the nucleus that contains genetic information
(c) cell membrane	(iii) point of attachment of spindle fibres during mitosis
(d) chloroplast	(iv) controls what enters and leaves the cell
(e) chromosome	(v) site of cellular respiration
(f) centromere	(vi) contains the cell's chromosomes
- Identify the parts of the cell shown in **Figure 1**. **K/U**

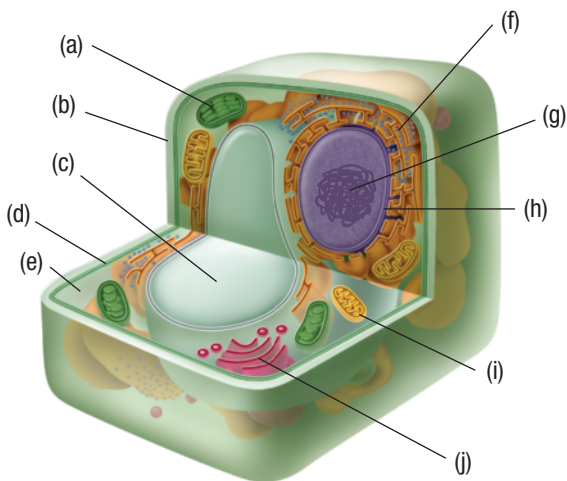


Figure 1

- Growth and reproduction are related to the processes of mitosis and cytokinesis. **K/U**
  - Explain how mitosis and cytokinesis are required for growth.
  - Explain how mitosis and cytokinesis can be used for the purpose of reproduction.
  - Can all organisms reproduce using cell division? Explain.

- Identify, and briefly explain, the function of each cell structure shown in **Figure 2**. **K/U**

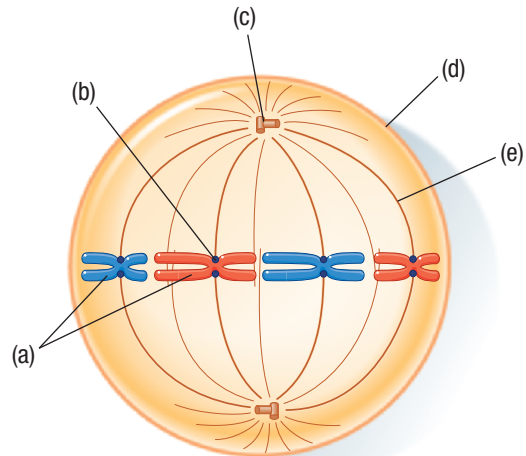


Figure 2

- (a) **Figure 3** shows a Frayer diagram for the term *prokaryote*. Copy the diagram into your notebook and complete it.

Definition	Key Characteristics
<div style="border: 1px solid black; border-radius: 50%; width: 100px; height: 100px; margin: 0 auto; display: flex; align-items: center; justify-content: center;"> <b>PROKARYOTE</b> </div>	
Examples	Non-examples

Figure 3

- Draw and complete a new Frayer diagram for the term *eukaryote*. **K/U T/I C**
- Explain the different ways in which mitosis and cytokinesis are useful for unicellular and multicellular organisms. **K/U A**
- Interphase is sometimes called the “resting” stage of the cell cycle. Why is this a poor description of interphase? **K/U**

8. (a) Is mitosis occurring in your body right now?  
(b) What types of cells do you think are undergoing mitosis and cytokinesis? **T/I A**
9. What is meant by each of the following terms? **K/U**  
(a) cell differentiation  
(b) asexual reproduction  
(c) sex cells
10. A particular plant cell was found to contain 32 chromosomes during interphase. What would happen to the number of chromosomes in the cell if the plant cell underwent mitosis but then did not undergo cytokinesis? **K/U T/I A**
11. Describe the relationship between cancer and  
(a) cell division  
(b) mutations **K/U**
12. Define sexual and asexual reproduction, and provide examples of organisms that use these methods. **K/U**
13. A cat breeder mated a black male cat with a white female cat. All of the kittens were either white or black; none of them were grey. Does this surprise you? What does the colour of the offspring suggest about the inheritance of hair colour? **K/U A**
14. Scientists are attempting to genetically modify banana plants so that they produce vaccines within their fruits (**Figure 4**). Rather than receiving a needle injection, children could be vaccinated simply by eating one or more of these bananas. Do you think this is a good idea? Why or why not? **A**
15. Identical twins are genetically identical to each other because they came from the same fertilized egg. **K/U T/I A**  
(a) Describe the physical characteristics they may share with each other.  
(b) Do you think the fact that they are genetically identical has any influence on how similar or dissimilar their personalities are?

## Skills Review

16. Suppose you are planning to use the high-power objective lens. **K/U**  
(a) Describe the steps needed to focus when using the high-power objective lens.  
(b) What is the function of the diaphragm?
17. Describe the key things you must remember when making a proper biological drawing. **K/U T/I A**
18. Draw and label a simple diagram of the cell cycle. Include labels for interphase, mitosis, and cytokinesis. **K/U A C**
19. (a) What is the purpose of using a biological stain?  
(b) Describe how you would apply a stain to a specimen you wanted to view under the microscope. **K/U T/I A**
20. Biologists are often interested in comparing the ratio of one variable to another. After collecting data, they often convert ratios to simple whole number ratios. For example, wildlife biologists counted 20 lynx and 180 snowshoe hares in a large ecosystem. These values can be expressed as a ratio of 20:180 or 1:9. The expression 1:9 represents the lowest whole number ratio and means that for every 1 lynx there were 9 snowshoe hares.  
Calculate the lowest whole number ratios for the following samples: **K/U T/I A**  
(a) 2000 mice and 40 snakes  
(b) 48 maple trees and 16 pine trees  
(c) 181 native crayfish and 543 invasive rusty crayfish  
(d) 30 yellow roses, 90 red roses, and 60 pink roses



**Figure 4** A banana plant



## CAREER PATHWAYS PREVIEW

Throughout this unit you will see Career Links in the margins. These links mention careers that are relevant to the study of genetics. On the Chapter Summary page at the end of each chapter you will find a Career Pathways feature that shows you the educational requirements of the careers. There are also some career-related questions for you to research.